Additional exercises – Some helpful tools to explore

- **Extracting spatial data – Create a map of Peru**
- **Adding, selecting, and symbolizing point data:**
- **Adding a locational map to a layout**
- **Examining projections.**
- **Creating Metadata**
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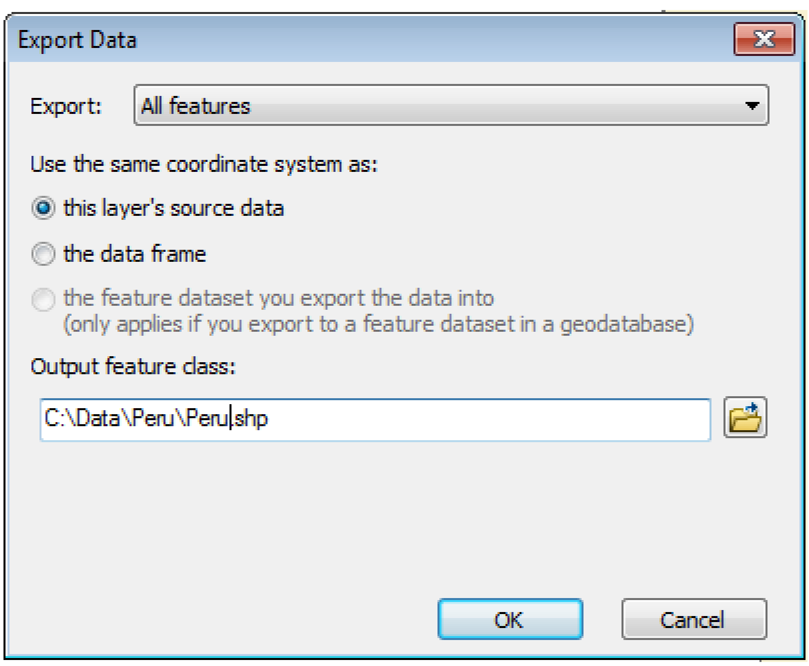
Extracting spatial data – Create a map of Peru

We can extract a subset of data to create a new map that defines the area of study. From a larger set of data, we can identify the spatial data, select the data, and create a new shapefile of the data.

1. **Add Data**: "AfricaAmericas_LSIB_Polygons_Simplified_2015Jan23_USG".
2. **Selection → Select by Attributes**: "CNTRY_NAME" = 'Peru'.
   Right click on "AfricaAmericas_LSIB_Polygons_Simplified_2015Jan23_USG"**.** **Selection → Create Layer from Selected Features**.
3. Right click on new Selected Features in table of contents. **Properties → General**. Layer Name: Peru.
4. **Clear Selection**. Remove "AfricaAmericas_LSIB_Polygons_Simplified_2015Jan23_USG". **Zoom to Layer.**
5. Right click on Peru. Select **Data → Export Data**. (This will convert the country boundary of Peru to a shapefile.)

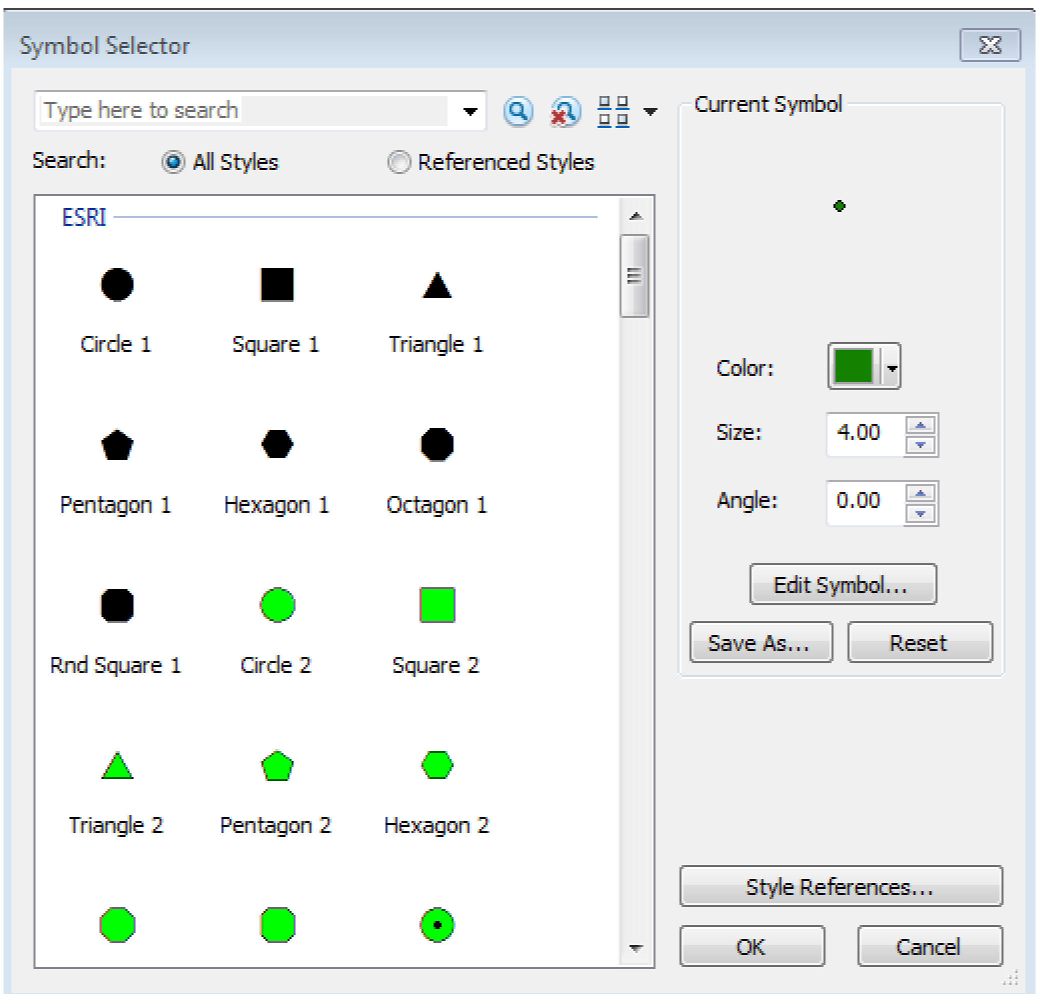


Now you have a base map of Peru.

Adding, selecting, and symbolizing point data:

Similarly, we can extract point data from a spreadsheet with geographic coordinates and add these data to our map. We can refine the dataset by selecting the points of interest and create a new shapefile.

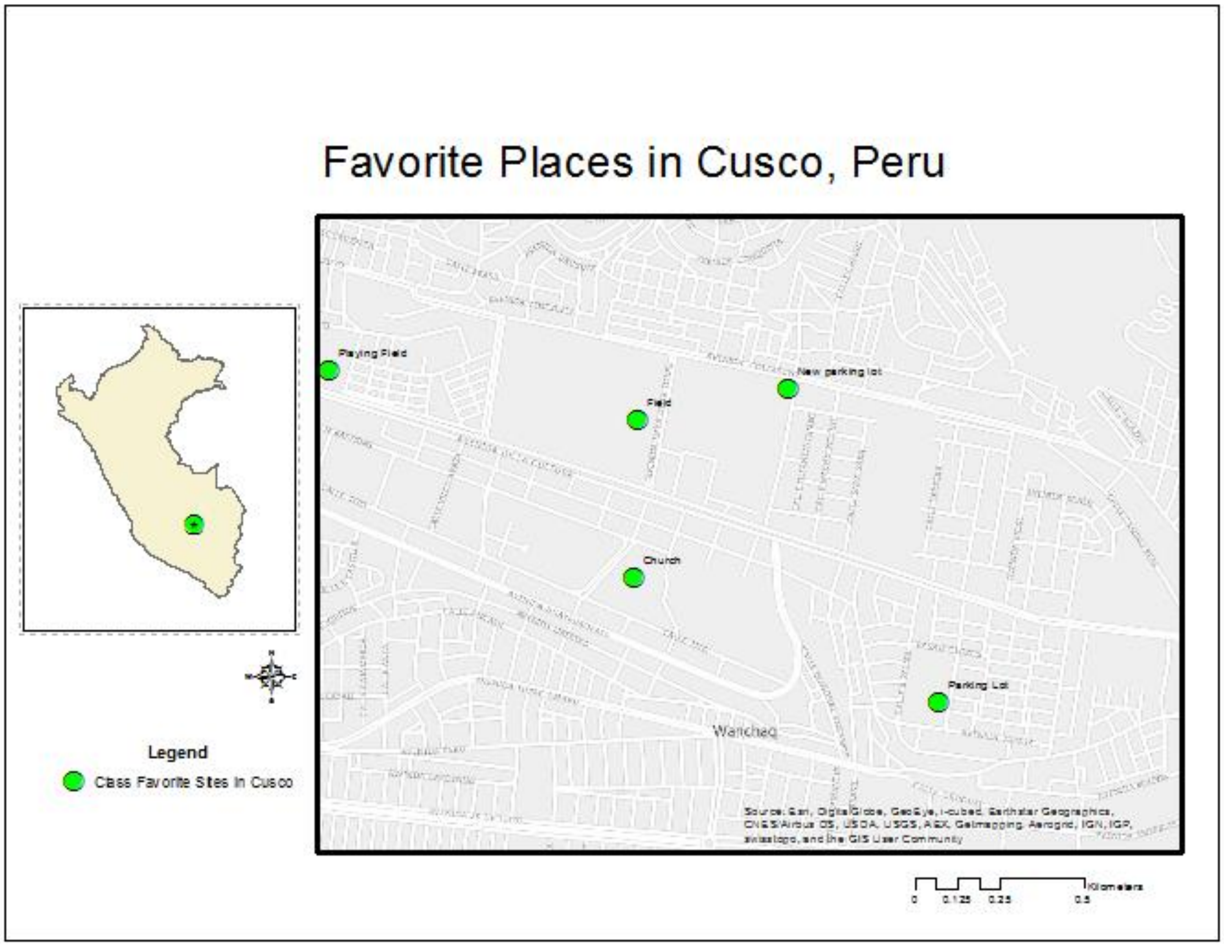
1. **Add Data**: SecondCit_Peru_arcgis.xlsx. Add Sheet1$.
2. Right click on Sheet1$. **Open** the table. We have X,Y coordinates and can add these geographic data to the map.
3. Right click on Sheet1$. **Display XY Data**. Click **OK**.
4. Right click on Sheet1$ Events. **Data → Export Data**. Give the new layer a meaningful name. Click **OK**.
5. Open the Peru Secondary Cities table and examine your data.
6. Extract Cusco from the set of Secondary Cities and make a shape file of it. (Follow the procedure you used to create the Peru shapefile.)
7. Be sure to clear your selection. Remove layers you don't need.
8. Make the marker for Cusco bigger to stand out on your map of Peru. Double click on the point icon for the city of Cusco in the table of contents. Change the color, size, shape of the icon.



Adding a locational map to a layout

We need to create maps that situate the location within a larger geographic context. This exercise will explain how to create an inset locational map in a map layout.

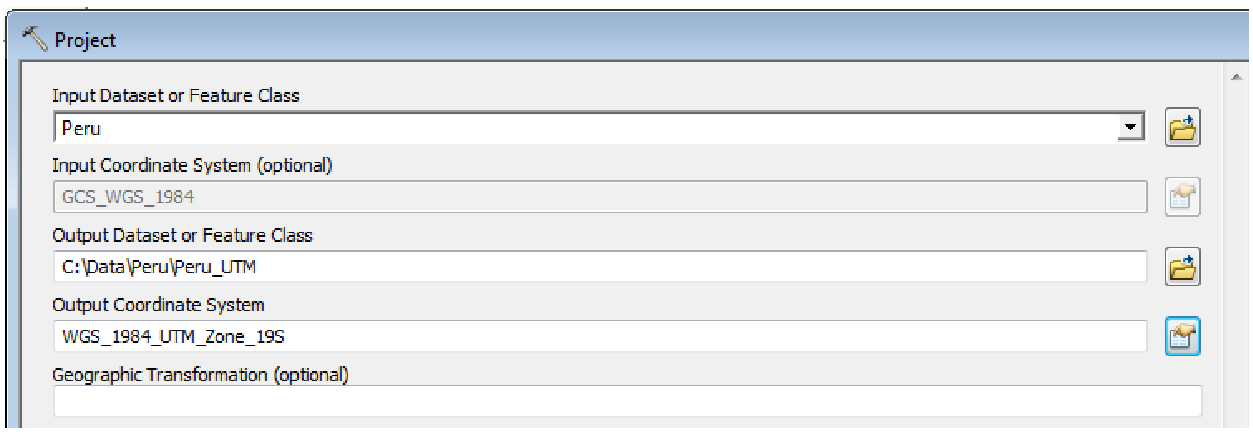
1. Add a new data frame to your table of contents: **Insert → Data Frame**.
2. **Add Data**: Peru shapefile and Cusco shapefile
3. Select **View → Layout View**. Examine the layout and add map elements.



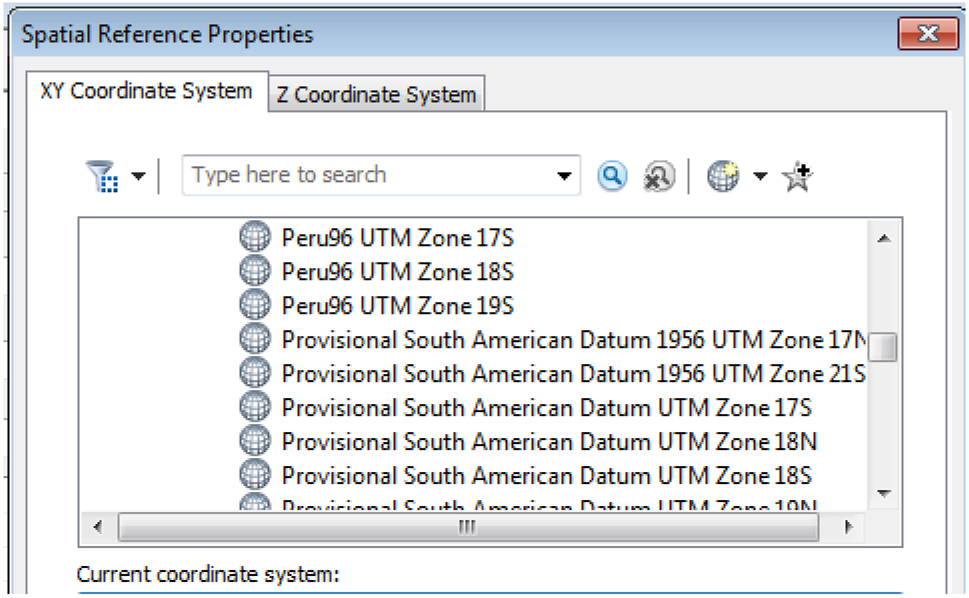
<u>Examining projections.</u>

Read: Map Projections in ArcGIS Help:
http://resources.arcgis.com/en/help/main/10.1/index.html#//003r00000010000000.

1. Right click on Peru. **Properties → Source**. Examine the coordinate information. The Coordinate System is GCS_WGS_1984 and the Datum is D_WGS_1984. GCS refers to Global Coordinate System which uses an angular unit of measure to measure the spherical surface of the earth. WGS refers to World Geodetic System. The datum, D_WGS_1984 refers to the standard spheroidal reference surface, the datum or reference ellipsoid.
2. We will project this layer into a commonly used projection for Peru. In the Toolbox , select **Data Management Tools → Projections and Transformations → Project**. Give your output a meaningful name. Select the output coordinate system –**XY Coordinate System → Projected Coordinate Systems → UTM →Southern Hemisphere → WGS 1984 UTM Zone 19S.**



3. The data is projected into a two-dimensional surface. Compare the two layers Source information. *What do you notice about them? What information is different between the two layers?*
4. We can project our data using PSAD 56: Provisional South American Datum 1956. **XY Coordinate→ Projected Coordinate System → UTM → South America →Provisional South American Datum UTM Zone 19S**



ArcGIS, projections and coordinate systems:

The coordinate system for a dataset must be specified for ArcGIS to properly align and display layers. An important function of GIS software is the ability to manipulate coordinate systems. There are two ways to manipulate coordinate systems in ArcGIS:

1) change the coordinates permanently through creating a new dataset that **projects** the data in a different coordinate system. To do this, you use the **Project tool** in **ArcToolbox.**

2) change the coordinates temporarily by on-the-fly projection based upon a different coordinate system defined by the dataframe in ArcMap. A dataframe's projection can either be explicitly set by the user or ArcMap will default to the projection of the first layer added. When subsequent layers are added to the map, they will automatically be projected into the default map projection.

On the Fly projection: On the fly projection refers to the ability of GIS layers to align correctly, even if different projections are defined for a datalayer. GIS databases place features in space using coordinate systems. Any GIS layer may utilize any of hundreds coordinate systems. Software such as ArcGIS can do a good job of temporarily transforming the coordinate systems of GIS layers, aligning them on-the-fly, provided these data have embedded metadata that accurately describes the coordinate system that is used to identify locations within the dataset. When data layers don't line up, it is because one data layer or another does not have the proper embedded coordinate system information.

On-the-fly projections are less mathematically rigorous than permanent projections. If you plan to use datasets in an exacting analysis, you should project them permanently to the same coordinate system with the **ArcToolBox Project Wizard**.

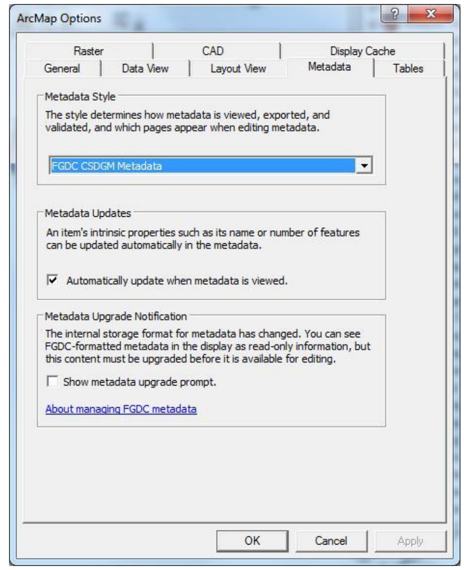
Creating Metadata

Metadata is the most important part of the data and the most overlooked aspect of data generation. When you create new data it is important to develop metadata – data about the data: where is came from, who created it, the date it was created, the projection and datum, definitions of fields, etc.

In ArcMap, enable Metadata by selecting a Metadata format. Customize → ArcMap Options → Metadata Tab.
There are various standards with **FGDC** the default for U.S. Government Agencies**.**

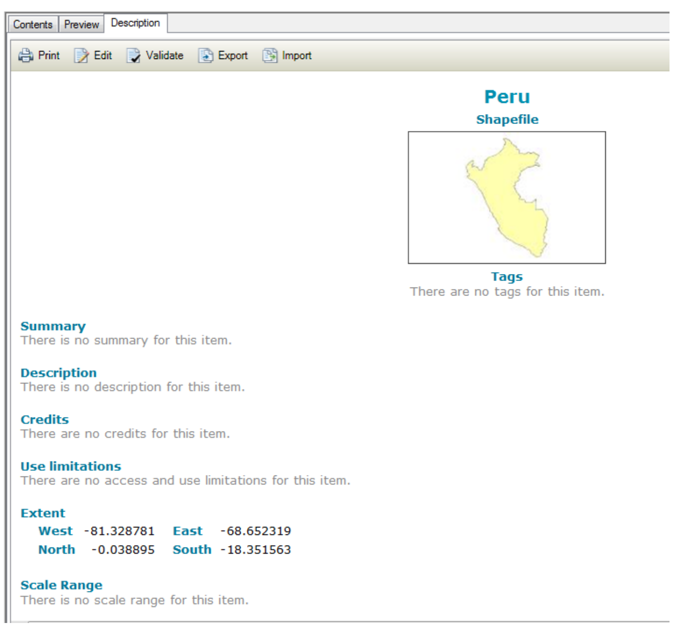
Select **FGDC CSDGM** from the dropdown menu.

Be sure the ***Automatically update when metadata is viewed*** box is checked!

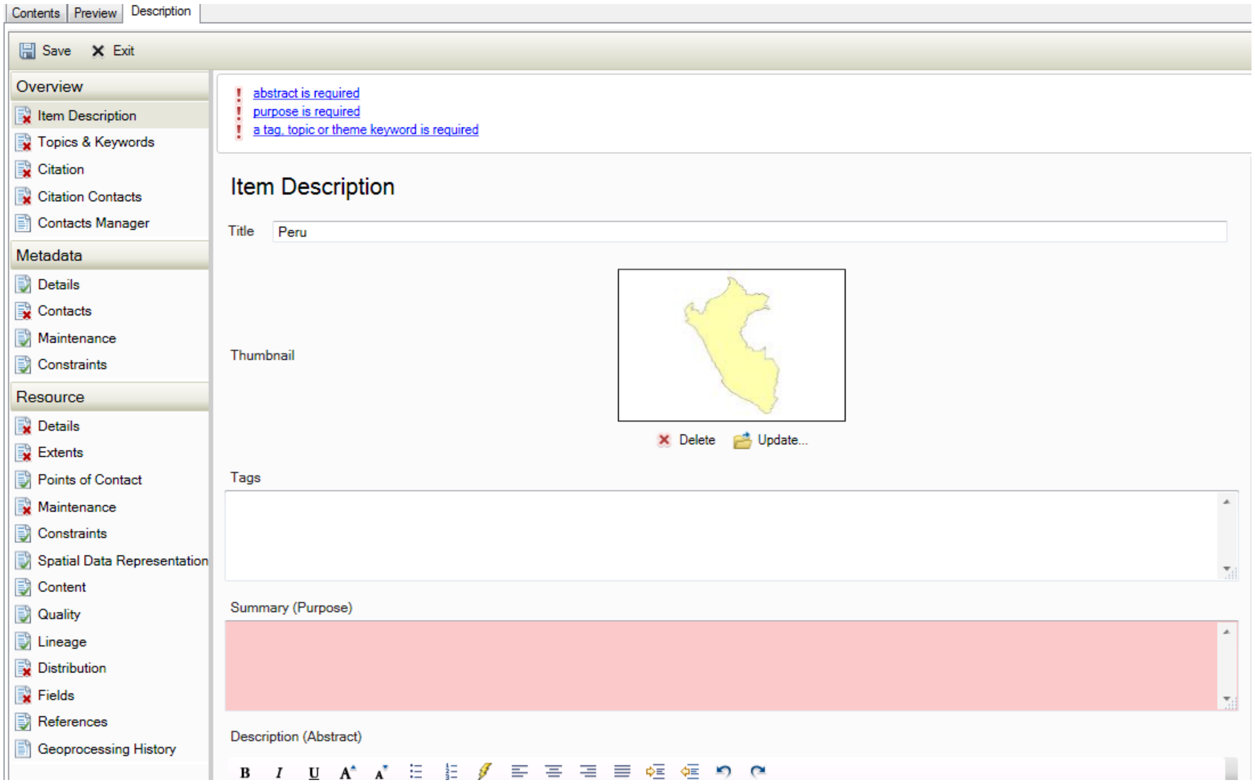


Open **ArcCatalog** . Navigate to the location of your shapefile file. Click on the file.
You will need to edit the basic metadata yourself.

- Click on the **Preview tab** in the upper corner of the window.
- Click on the **Create Thumbnail button**  **on the main tool bar**. Return to the **Description** tab.



- Click on the **Edit** button. Fill in the boxes with the required text:



You can also set Metadata in ArcCatalog:

Select **Customize → ArcCatalog Options → Metadata**. Check the box next to **Automatically update when metadata** is viewed in the middle of the window.

NOTE: In **ArcCatalog,** XML metadata can be imported into ArcGIS using the **Import Metadata** tool under the **Description** tab.

Working with Raster data

SRTM Shuttle Radar Topography Mission

http://www.jpl.nasa.gov/news/news.php?release=2014-321

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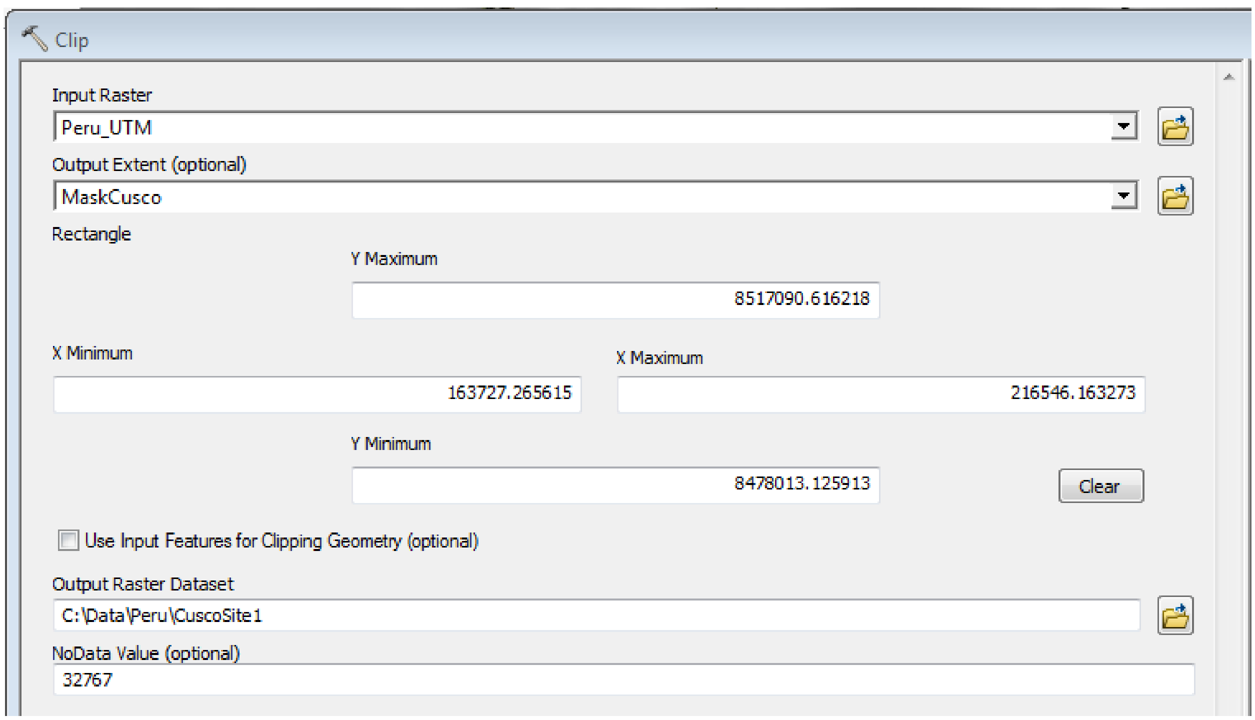
We have SRTM data that provides elevation data for the region. We will click out a smaller portion of the SRTM data, fill the voids in the data and create new raster data using SRTM.

Setting a mask and clipping the raster:

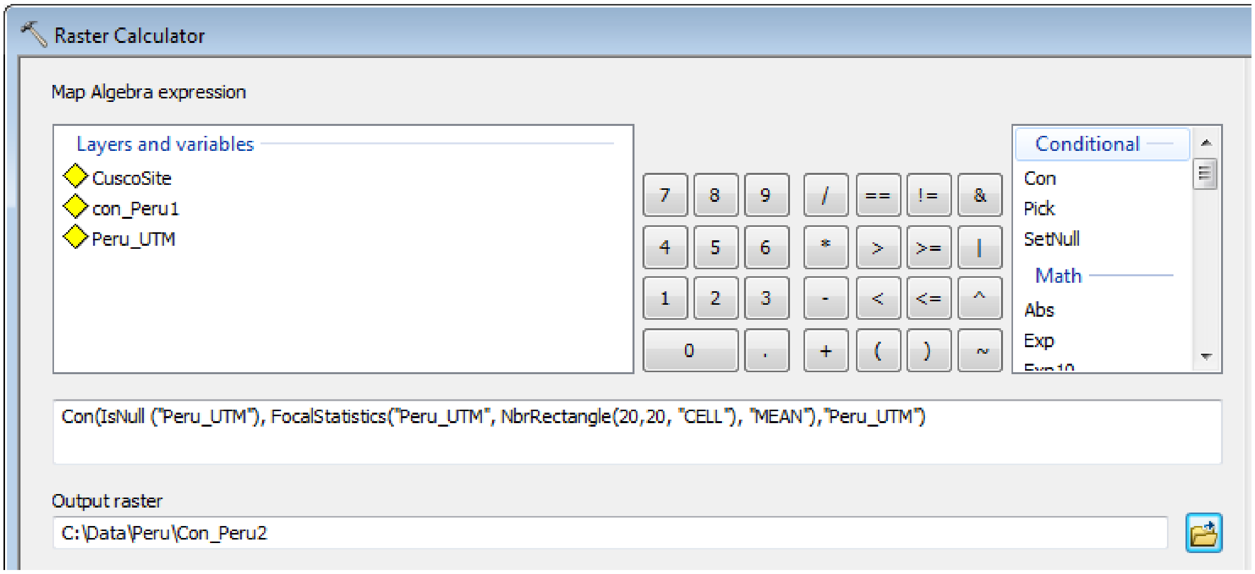
1. From the **Draw** tool bar, select rectangle to draw a rectangle around the study of interest. In this case, we will draw a box around the city of Cusco.
2. Right click on the **Data Frame** title. Select **Convert Graphics to Features**. Give the new layer a meaningful name: MaskCusco.
3. **ArcToolBox → Data Management Tools → Raster → Raster Processing → Clip.** This process allows us to extract a smaller area to use. This targets the study site and improves the performance of processing the data.



4. Notice there are some gaps in the data. We can fill these gaps (NODATA) by using the surrounding cells to calculate the mean of these surrounding cells and give the voids a value. **NOTE:** We would want to be sure to check our data and be sure the number of cells we use is appropriate for calculating new data.

   a. **ArcToolBox → Spatial Analyst →Map Algebra → Raster Calculator**

In the **Raster Calculator**, enter this expression (we will use Python syntax for our Map Algebra expression):



Where:
Con: a conditional statement on each of the cells of a raster
IsNull: Identifies the NODATA cells of the input raster
In this instance, “Peru_UTM” is the input raster. The input raster must be in “ “.
FocalStatistics: Calculates the each input cell location a statistics based on the specified neighborhood.
In this instance, the neighborhood is defined as a rectangle (**NbrRectangle**), made up of **20** (width) X **20** (height) neighboring **CELL**s and calculates the **MEAN** (average value) of the cells in the neighborhood of the input raster.

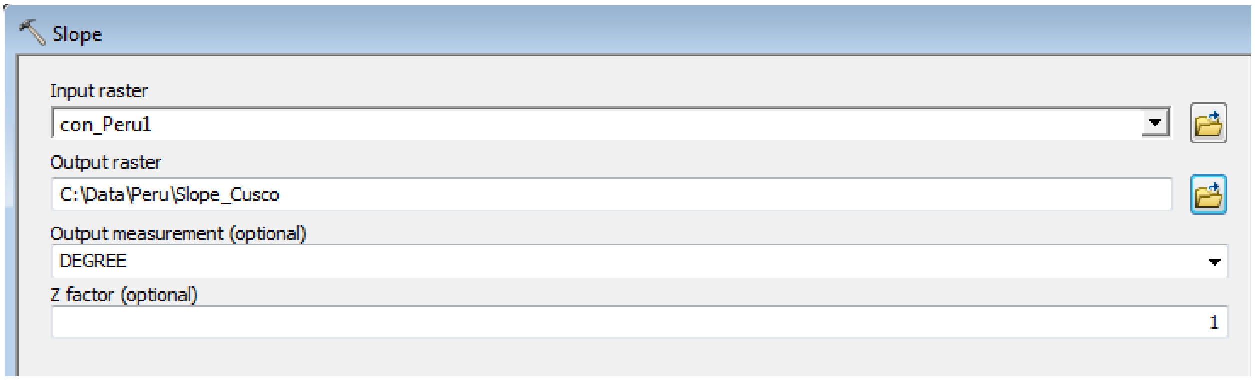
NOTE: The exact syntax for a map algebra expression must be followed or the calculation will fail.

Once you run this expression, note that most of the voids are filled. You can use the Identify tool  to see what the values are.

Now we can do some interesting spatial analysis of our raster data. There a many tools in the Spatial Analyst toolbox that provide robust analytical capabilities.

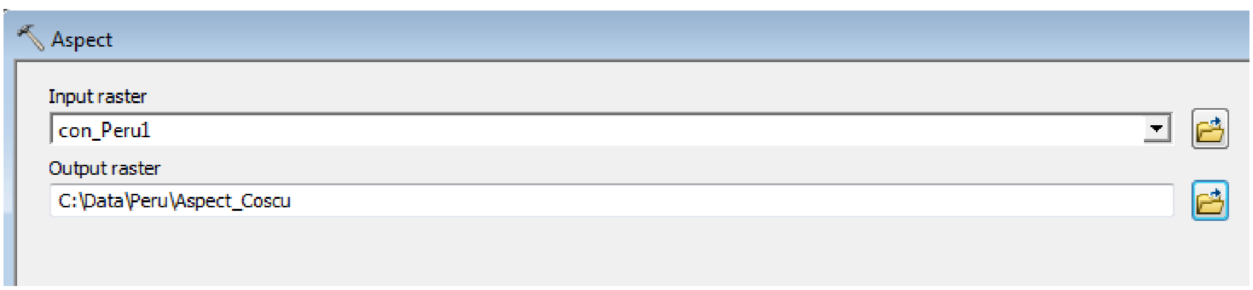
b. ArcToolBox → Spatial Analyst Tools → Surface → Slope

Identifies the slope or gradient of each cell in the raster in either DEGREEs or PERCENT RISE.



c. **ArcToolBox → Spatial Analyst Tools → Surface → Aspect**

Aspect is the slope direction and is the compass direction of the aspect. The default classification Includes 10 categories: Flat (-1), North (0 – 22.5), Northeast (22.5 – 67.5), East (67.5 – 112.5), Southeast (112.5 – 157.5), South (157.5 – 202.5), Southwest (202.5 – 247.5), West (247.5 – 292.5), Northwest (292.5 – 337.5), North (337.5 – 360).



d. **ArcToolBox → Spatial Analyst Tools → Surface → Hillshade**
Creates a shaded relief from a raster by using the sun's azimuth and altitude – the illumination source angle and shadows.